International Journal of Agricultural
Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 4, Issue 3, Jun 2014, 45-56

WHAT DOES THE EUROPEAN STARLING EAT (*STURNUS VULGARIS*) IN ALGERIA, REGION OF ITS WINTERING AREA?

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ABSTRACT

In the region that includes the Mitidja plain and Great Kabylie, the European starling is considered a major pest of the olive tree especially the cultivated one. It is a question of specifying the trophic components of this species in Mitidja which belongs to its wintering area. In the Starling's food menu, the vegetal part is mainly not olives, but dominated by Pistachio-mastic fruits. As for the animal part, far more important than the vegetal part, is mainly insects Coleoptera and Hymenoptera. A better understanding of the diet of this Sturnidae will improve the methods to fight against it. The analysis of the stomach contents of starling captured and sacrificed explain the proportions of vegetal and animal trophic components.

KEYWORDS: European Starling, Food Intake, Wintering Area, Algeria

INTRODUCTION

The European starling (*Sturnus vulgaris*) or "Azerzour" as it is designated in Berber in the Maghreb where it comes to hibernate, is considered as the main bird pest of the olive in Algeria (Gramet 1978) "Figure 1". We must remember that in some countries of northern Europe farmers consider the European starling as an auxiliary and even install nest boxes for it to promote its reproduction. The qualification of this avian species as harmful or useful is of great complexity. This study seeks to complement previous work particularly with regard to diet and the aim is to refute or confirm the observations made by different researchers among others on its trophic bioecology and the relative importance of insect prey and vegetal intake.

Figure 1: Original Photography of *Sturnus vulgaris* in his Wintering Area

METHODS

It is the eastern part of the Mitidja which holds the attention in this work (36°32' to 36°49'N., 3°03' to 3°25'E.) (I.N.C.T. 2004). The eastern part of the Mitidja, one of the most fertile plains in Algeria, and well watered, is used by locals for various crops, such as citrus, apple, medlar, vineyards, vegetables and cereals (Wojterski 1985).

According Loucif-Seiad (2002) and Imache *et al.* (2007), Mitidja has significant hydro-agricultural potential. The climate is Mediterranean, the Mitidja characterized by alternating mild or cool and wet winters and hot, dry summers (Seltzer 1946).

The field trips were conducted between November 2006 and March 2007 for capturing starlings at the cemetery of El Alia (36°42'N., 3°09'E.) And two plots left lying fallow located in Larbâa one (36°33'N.; 3°09'E.) and the other in Rouiba (36°44'N.; 3°17'E.). The analysis focused on 50 digestive tracts recovered after sacrifice and dissection of starlings captured. The contents of the digestive tracts are recovered individually in Petri dishes to determine prey species and plants ingested and to quantify them. Determinations are carried out at the Laboratory of Zoology Agricultural of the National School of Agronomy El-Harrach.

The exploitation of the results is made with ecological indices such as relative abundance, Shannon-Weaver diversity and equidistribution and statistical techniques. The relative abundance (RA %) expressed as a percentage by the formula RA % = n/N × 100 where n is the total number of individuals of a species i considered and N is the total number of individuals of all species (Faurie *et al.* 1984). In this case n is the number of species recorded in the stomach contents while N represents all invertebrates found in the stomach contents.

The diversity index of Shannon-Weaver is considered as the best way to reflect the diversity expressed by the formula H'(bits) = - $\sum$ (ni/N) Log_2(ni/N) where ni is the number of individuals of species i and N is the total number of individuals of all species (Blondel *et al.* 1973). According to Weesie and Belemsobgo (1997), the equal distribution is the ratio E = H '/ H'max. where H' is the diversity index of Shannon-Weaver, H 'max. maximum diversity is given by H' max. = log2 S and S is total wealth expressed in number of species. According to De Falguerolles and Van Der Heijden (1987) Factorial Correspondence Analysis (FCA) is an extension of the methods of analysis of contingency tables with multiple dimensions. In this study, the use of AFC can highlight the differences between prey species found in the starling's diet according to the stations and the months. The analysis of the variance in a criterion of classification or in a factor, aims to compare the averages of several populations assumed normal and the same variance from random samples, simple and independent of each other (Rice 1989).

RESULTS

The content analysis of the digestive tract of *Sturnus vulgaris* shows that the animal species are 5 times more than the ingested plant species "Table 1". The total number of species consumed by European starling is 157 represented by 1123 individuals. Between the three stations in the eastern part of the Mitidja, the number of species observed and ingested varies between 64 in El Alia and 138 in Larbaâ. Among the most requested food plants *Pistacia lentiscus* (Anacardiaceae) comes first with 111 fruits. It is followed by 49 olives (*Olea europaea*, Oleaceae) then by *Ficus* sp. (Moraceae) with 11 elements and *Triticum* sp. (Poaceae) with 2 elements only. The animal part ingested is especially Formicidae in which, *Tapinoma nigerrimum* participates with 92 individuals and 84 individuals by *Messor barbara* on 1123 food intake.

Table 1: List of Plant and Animal Species Found in the Digestive Tracts of Starling from Three Stations Catches (East-Mitidja)

Stations Catches			Rouiba	El Alia	Larbaâ	
Number of Guts Examined			10	10	30	
Classes	Orders	Families	Numbers	Numbers	Numbers	Total
Gastropoda	Pulmonata	Helicidae sp.	4	1	5	10
		Helicellidae sp.	-	4	8	12

Table 1: Contd.,

Arachnida	Pseudoscorpionida	Pseudoscorpionida f. ind.	-	-	2	2
	Ricinuleida	Ricinuleida f.ind.	4	2	5	11
	Aranea	Aranea f. ind.	1	1	3	5
		Dysderidae sp.	-	-	2	2
Myriapoda	Chilopoda	Chilopoda f.ind.	-	-	7	7
		Himantariidae	-	-	1	1
	Diplopoda	Julidae	-	-	16	16
Crustacea	Isopoda	Oniscidae f. ind.	3	7	10	20
Insecta	Blattoptera	Blattoptera f. ind.	4	3	2	9
		Ectobiidae sp.	2	3	2	7
	Orthoptera	Gryllidae sp.	1	-	2	3
		Acrididae sp.	6	-	4	10
	Dermaptera	Dermaptera f. ind.	3	2	2	7
		Anisolabidae	4	4	4	12
		Labiduridae	-	-	3	3
	Mallophaga	Menoponidae	-	1	-	1
	Heteroptera	Heteroptera f.ind.	-	-	2	2
		Pentatominae sp.	3	1	2	6
		Reduviidae sp.	1	1	2	4
		Lygaeidae sp.	2	2	5	9
		Cydnidae	2	-	3	5
		Pentatomidae	1	-	4	5
	Homoptera	Aphidae sp.	4	1	2	7
	Coleoptera	Coleoptera f. ind.	-	3	4	7
		Caraboidea sp.	1	2	2	5
		Harpalidae sp.	3	1	5	9
		Carabidae	4	1	10	15
		Scaritidae sp.	1	-	-	1
		Lebiidae sp.	1	-	4	5
		Melolonthidae	2	6	6	14
		Orphnidae	5	1	10	16
		Aphodiidae	6	8	16	5
		Scarabeidae sp.	3	-	6	9
		Cetonidae	1	-	3	4
		Tenebrionidae sp.	9	6	33	48
		Phalacridae	-	-	3	3
		Elateridae sp.	4	1	9	14
		Mycetophagidae	-	-	3	3
		Carpophilidae sp.	-	-	4	4
		Chrysomelidae	11	8	15	34
		Anthicidae	2	3	3	8
		Staphylinidae sp.	5	6	8	19
		Sylvanidae sp.	1	-	4	5
		Histeridae	2	1	4	7
		Coccinellidae sp. ind.	2	1	4	7
		Cerambycidae sp.	2	1	-	3
		Curculionidae sp.	20	32	81	133
	Hymenoptera	Ichneumonidae sp.	-	-	5	5
		Halictidae sp. ind.	1	-	4	5
		Apidae	-	-	1	1
		Andrenidae	-	-	2	2
		Formicidae sp.	119	57	162	338
	Diptera	Diptera f. ind.	1	-	2	3

		Cyclorrhapha sp.	1	2	2	5
		Nematocera f.ind.	-	-	1	1
Vegetable family		Poaceae	-	2	-	2
		Moraceae	4	2	5	11
		Oleaceae	6	3	48	57
		Anacardiaceae	8	25	78	111
		Plantae sp. ind.	1	2	2	5
Total Numbers of Individus			**271**	**207**	**645**	**1.123**
Total Numbers of Species			**82**	**64**	**138**	**157**

Diet Composition According to Classes and Orders

The prey identified belong to 5 classes, Gastropoda, Arachnida, Myriapoda, Crustacea and Insecta. The class which the individuals are the most sought after by Starling is the Insecta with 240 individuals near Rouiba (88.6%), 159 individuals in El Alia (77.2%) and 450 individuals near Larbaâ (69 8%) for a total of 849 insects among 1123 trophic components “Figure 2”.

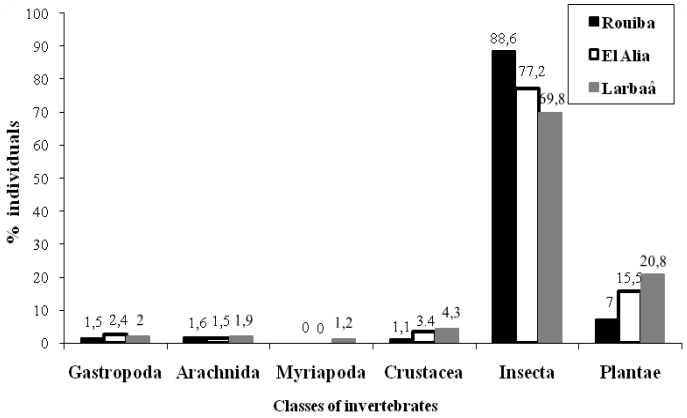

Figure 2: Distribution of Animal and Plant Species Consumed by European Starling According to Taxonomic Classes in the Three Study Sites

The dominance of insects indicates a clear preference of *Sturnus vulgaris* for this class although it’s his hibernating area. Insects listed in the trophic menu of the Starling during this study belong to 9 orders , Blattoptera, Orthoptera, Dermaptera, Mallophaga, Heteroptera, Homoptera, Coleoptera, Hymenoptera and Diptera “Table 2”. The order of the Insects the most represented in the diet of *Sturnus vulgaris* is the Coleoptera with 401 individuals (47.1%), followed by Hymenoptera with 351 individuals (41.3%).

Table 2: Distribution of Species of Insecta Ingested by *Sturnus vulgaris* According to the Orders

Stations Catches	**Rouiba**		**El Alia**		**Larbaâ**		**All of Stations**	
Numbers of the Digestive Tract Studied	**10**		**10**		**30**		**50**	
Orders	**n.**	**%**	**n.**	**%**	**n.**	**%**	**n.**	**%**
Blattoptera	6	2,50	6	3,80	4	0,88	16	1,88
Orthoptera	7	2,92	0	0,00	6	1,32	13	1,53
Dermaptera	7	2,92	6	3,80	9	1,99	22	2,59
Mallophaga	0	0,00	1	0,63	0	0,00	1	0,12
Heteroptera	9	3,75	4	2,53	18	3,97	31	3,64
Homoptera	4	1,67	1	0,63	2	0,44	7	0,82
Coleoptera	85	35,42	81	51,27	235	51,88	401	47,12

Table 2: Contd.,

Hymenoptera	120	50,00	57	36,08	174	38,41	351	41,25
Diptera	2	0,83	2	1,27	5	1,10	9	1,06
Total	**240**	**100**	**158**	**100**	**453**	**100**	**851**	**100**

n: Numbers of individuals consumed ; **%** : percentages of individuals

Monthly Composition of the Starling's Trophic Menu

It is in February that 282 trophic components," the highest number" are counted in the digestive tracts of starlings captured in Larbaâ "Table 3". This number is followed by 271 units of food observed in November near Rouiba and 224 individuals in March near Larbaâ. During the first half of the winter the trophic components consumption seems less, 207 individuals in December in El Alia and 139 individuals in January near Larbaâ. It is possible that *Sturnus vulgaris* is more active in seeking its food in February in one hand to fight against the cold, and in the order to replenish its reserves for its migration to Europe. After its arrival in North Africa, the starling starts reconstituting its reserves exhausted during its journey towards its hibernation area.

Table 3: Numbers Plant Fragments and Animal Species Consumed by the Starling Counted per Month

	Stations Catches				
	Rouiba (in 2006)	**El Alia (in 2006)**	**Larbaâ (in 2007)**		
Months	**XI**	**XII**	**I**	**II**	**III**
Numbers of the digestive tract studied	10	10	10	10	10
n.	271	207	139	282	224
%	24,1	18,4	12,4	25,1	20

n: Numbers of individuals consumed; **%** : percentages of individuals

Relative Abundances of the Ingested Species and the Diversity of the *Sturnus vulgaris* Diet

In the *Sturnus vulgaris* digestive tracts the dominant species in November in Rouiba are *Messor Barbara* (in swarming period), *Tapinoma nigerrimum*, *Tetramorium biskrensis*, *Pheidole pallidula*, *Aphaenogaster testaceo-pilosa* and *Pistacia lentiscus* "Table 4". December in El Alia, the dominant species are *Pistacia lentiscus*, *Tapinoma nigerrimum*, *Messor barbara*, *Rhyssemus* sp., *Aphaenogaster testaceo-pilosa*, *Otiorrhynchus* sp. and Oniscidae sp. ind. Larbaâ in January, the species that dominate are *Pistacia lentiscus*, *Olea europaea* and *Tapinoma nigerrimum*. In Larbaâ station in February, the most common species in descending order are *Pistacia lentiscus*, *Olea europaea*, *Messor barbara*, *Hypera* sp. 2, *Hybalus* sp. *Lithoborus* sp., *Tapinoma nigerrimum*, *Hypera* sp. 1, Oniscidae sp. ind., *Rhyssemus* sp., *Iulus* sp., *Rhizotrogus* sp. and *Sitona* sp. Finally, in March Larbaâ, it is *Tapinoma nigerrimum*, *Messor barbara*, *Aphaenogaster testaceo-pilosa*, *Pistacia lentiscus*, *Olea europaea* and *Iulus* sp. appear to be the most important.

Table 4: Relative Abundance (RA %) of the Most Important Species Consumed by Starling

Stations Catches	**Rouiba**	**El Alia**	**Larbaâ**		
Months	**XI**	**XII**	**I**	**II**	**III**
Iulus sp.	0	0	2,16	2,48	2,68
Oniscidae sp. ind.	1,11	3,38	1,44	2,84	0
Rhizotrogus sp.	0,74	2,9	0	2,13	0
Hybalus sp.	1,85	0,48	0	3,55	0
Rhyssemus sp.	1,11	3,86	0,72	2,84	2,23
Lithoborus sp.	1,48	0	0	3,55	0
Otiorrhynchus sp.	0,74	3,38	0	0,71	0,89

Table 4: Contd.,

Hypera sp. 1	1,48	1,45	0,72	3,19	0
Hypera sp. 2	0,74	1,93	0	4,26	0,45
Sitona sp.	0,74	0	0	2,13	0
Tetramorium biskrensis	5,54	0	0	1,06	0,89
Tapinoma nigerrimum	8,12	8,7	7,91	3,55	13,84
Messor Barbara	11,44	5,31	3,6	4,61	10,71
Aphaenogaster testaceo-pilosa	3,32	3,38	1,44	1,06	4,46
Pheidole pallidula	4,43	2,9	0,72	0,71	0,89
Olea europaea	1,11	1,45	15,11	4,96	3,57
Pistacia lentiscus	2,95	12,08	28,78	9,93	4,46

AR %: Relative abundance; I, II, III: months.

The values of Shannon-Weaver diversity (H') calculated based on the number of different components of the Starling's trophic diet vary from one month to another and from one station to another. They fluctuate between 4.2 and 5.9 bits. The equitability (E) differs from one month to another during this study "Table 5". However, it remains equal or greater than 0.77. Of this fact the number of vegetal and animal species contained in the digestive tracts of starlings from Rouiba, El Alia and Larbaâ tend to be balance between them.

Table 5: Values of Diversity Index of Species Ingested by *Sturnus vulgaris* in Different Stations Catches in 2006 and 2007

Stations Catches	Month Catch	Numbers Guts Dissected	N	S	H' (Bits)	H' Max. (Bits)	E
Rouiba	XI (2006)	10	271	82	5,68	6,39	0,89
El Alia	XII (2006)	10	207	64	5,37	6,03	0,89
Larbaâ	I (2007)	10	139	42	4,18	5,42	0,77
Larbaâ	II (2007)	10	282	103	5,94	6,72	0,88
Larbaâ	III (2007)	10	224	83	5,57	6,40	0,87

N: numbers of individuals consumed; S: total wealth; H': diversity index of Shannon-Weaver; H' max : maximum diversity; E : equitability index

Factorial Analysis of the Correspondences of the Species Consumed

In this study Larbaâ (LRB) participates in the axis 1construction with 46.6%, followed by El Alia (ELA) with 43.0%. Rouiba (RBA) occurs more slowly (10.4%). Then it is Rouiba (RBA) which occur more in the construction of axis 2 with 61.2%, followed by El Alia (ELA) with 34.9%. The spatial distribution of species involved in the supply of *Sturnus vulgaris* in the factorial plan 1-2 highlights four groups, A, B, C and D. A includes the species omnipresent as *Messor barbara* (140), *Olea europaea* (154) and *Pistacia lentiscus* (155). B includes trophic components found in the starlings digestive tracts captured at Rouiba (RBA) in particular *Chaetocnema* sp.1 (094) and *Chrysomela banksi* (096). C combines species recorded in the diet of starlings only mentioned in El Alia (ELA) as *Menopon* sp. (025) and *Micrositus* sp. (062). D point cloud formed by the species found in the digestive tract of the starlings captured at Larbaâ (LRB) as *Nala lividipes* (024), *Harpalus fulvus* (038) and *Tropinota squalida* (054).

Variance Analysis Applied to Ingested Species

The exploitation of the trophic components found in the *Sturnus vulgaris* diet captured in three stations in eastern Mitidja, by a variance analysis shows that there is no significant difference between the three stations, knowing that F calc. = 0.64 <F theo. = 3.68, p = 0.54).

DISCUSSIONS

In Northern Europe, the breeding of *Sturnus vulgaris* in a farm in Turkew Poland, Gromadzki (1969) found that level out of 85 Starlings digestive tracts captured during the nesting period, the animal part portion ingested is 5 times higher than the vegetal one. He counted about 71 species represented by 3,953 individuals. The number of species recorded in this study is higher. This is explained by the fact that in its northern breeding area starlings is demanding in the choice of prey back to the nest to feed its nestlings, while during the winter the food he ingests belong to a much larger range. On average, the number of individuals consumed by digestive tract of the Starlings is higher in its breeding range (46 individuals) as noted in its hibernating area (22 individuals). It must be highlighted that the work of both sides of the Mediterranean includes two different areas in relation to the behavior of the starling. North is its breeding area, and south, its wintering one.

On the banks Reghaïa's Marsh in October 1988, Doumandji and Doumandji-Mitiche (1994) observe *Sturnus vulgaris* currently ingest fruits of *Pistacia lentiscus* and *Olea europaea*. These same authors in 1996 noticed the Starling rejecting many small cores oleaster (*Olea europaea oleaster*), large nuclei olive (*Olea europaea europaea*) and even seeds Palmaceae such as *Washingtonia filifera* and *W. robusta*.

In one week starlings rejected or dropped on the ground under an olive tree isolated in the gardens of the National Agronomique Institute El Harrach nearly 60,000 oleastre small nuclei. Similarly, Bortoli (1970) notes that in Tunisia the whole olives swallowed occupy three-quarters of the starlings diet. It seems that the *Sturnus vulgaris* intake of fruit in breeding area is less important than the hibernation one. Gromadzki (1969) in Poland counted 10 plant species in the stomach contents of 85 starlings during the period from February to September. These include *Triticum vulgare* Vill., *Myosotis* sp. and *Cerasus avium* (L.) Moench. In Nelson's forest (41°17'S., 173°15'E.) in New Zealand, Williams and Karl (1996) found in the *Sturnus vulgaris* droppings fragments of Elderberry fruit (*Sambucus nigra*, Caprifoliaceae) and have observed it in the process of consuming apple-kongourou of Tasmania (*Solanum aviculare*, Solanaceae), the matai or dark Pine *Prumnopitys taxifolia* (Prumnopityaceae), white pine *Dacrycarpus dacrydioides* (Podocarpaceae) and Tikoti *Alectryon excelsus* (Sapindaceae). Isotti (1997) in a suburban environment near Rome observe during the pup rearing in April the absence of the vegetal part while in May the vegetal part is represented by the ingestion of cherry (*Prunus avium*). This is because the cherry is ripe in May and still green in April. According to several authors European starling can ingest different berries and fruit crops such as tomatoes, strawberries, blueberries, peaches, apples, pears, figs, grapes and cherries and ornamental plants such as elderberries and blackberries (Brown 1981; Feare *et al*. 1992). In very cold weather, European starling complements its diet with soft seeds taken from maize silage fodder for cattle or, in plots recently planted in winter cereals where it collects the germinate seeds (Clergeau 2000). In forest, the starling seems to be attracted by the podocarpe of *Cordyline australis* (Liliaceae) and *Fuchsia excorticata* (Onagraceae) but especially by *Solanum nigrum* (Karl and Williams 1996). It is likely that in his breeding area, *Sturnus vulgaris* search more fruits rich in complex carbohydrates and simple sugars while in its wintering area it falls back on diaspores containing high amounts of fat, such as olive, *Pistacia lentiscus* fruits and dates of *Whashingtonia robusta*, *W. filifera* and *Phoenix canariensis*. In addition, Western Hutt hills in the south-west coast of New Zealand (41°12'S., 174°55'E). Gibb (2000) note 57 Ficus carica figs in the diet of *Sturnus vulgaris*. Wild fruits consumed constitute 15.2% of the total food ingested according to Havlin and Folk (1964) cited by Cramp & Perrins (1994). In New York, Karasov (1996) and Starck (1999) note that the plant part constitute a large proportion in the starlings diet during the autumn and winter.

Doumandji and Doumandji-Mitiche (1994) note by the coastline, acrobatic flights in early autumn, made by starlings to capture swarming *Messor barbara* ants. Havlin and Folk (1964) cited by Cramp & Perrins (1994) noted in 336 *Sturnus vulgaris* stomach contents between March and November 1964 that the animal species ingested are part of Hymenoptera (24.2%) with 22.6% of Formicidae and 21.5% of Coleoptera. Other authors rightly point out that the starling's food is both animal and vegetal throughout the year with a predominance of the animal part during the spring and especially during the feeding of nestlings (Karasov 1996; Starck 1999).

Diet Composition According to Classes and Orders

Near Beaulieu (36°43'N., 3°09'E.), Doumandji and Doumandji-Mitiche (1994) note the use of pupae and millipedes Iulidae in the soil by *Sturnus vulgaris*. Tinbergen (1981) in Schiermonnikoog in waddenzee island during the nesting period noted in the diet of *Sturnus vulgaris* 3 classes of invertebrates the Oligochaeta, the Arachnida and Insecta. It is noteworthy that starlings seek their prey mainly at ground level. Trotta (2001) reported six classes of animal species consumed by European starling in the western periphery of Rome. These are the Oligochaeta, the Gastropoda, the Arachnida, the Myriapoda, Insecta and the Reptilia. Although the above study areas are different from each other and belong to different biological areas, the trophic diet of *Sturnus vulgaris* include classes belonging essentially to invertebrates, which shows a great similarity between the menus . According to Isotti (1997) European starling has preferences during the breeding ground for insect larvae (caterpillars) and insect with soft integument. Trotta (2001) notes the presence of 84.1% of insects in the diet of adults *Sturnus vulgaris* and 80.1% among the youth. According to the same author, the percentage of insects in the diet of young Starlings in the nest is 78.7% while that of young flying Starlings was 84.1%.

Similarly in central New Mexico Moore (1986) found nine orders with seven of Insecta, the Heteroptera, Homoptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera. To these must be added Isopoda and Araneida found in 105 gizzards of the *Sturnus vulgaris*. In the North of Havelock in the North Island of New Zealand, Moeed (1975) found eight orders of Insecta in 19 starlings gizzards collected in December 1974 at bird houses. He noted Odonata, Orthoptera, the Dermaptera, the Heteroptera, the Coleoptera, Hymenoptera, Lepidoptera and Diptera. In the same country and in the breeding area of the starling Coleman (1977) found in 406 Starlings gizzards 14,808 Coleoptera individuals 56.6%. He identifies about four orders of insects with the Heteroptera, Coleoptera, Lepidoptera and Diptera. Apparently in particular environments the diversity of the orders which the pray belongs to are low.

Monthly Composition of the European Starling Trophic Menu

In the area of reproduction, in the Western Hutt hills in the south-west coast of New Zealand, Gibb (2000) notes the presence of 6 figs *Ficus carica* just in March. This number fluctuates between 19 and 31 over the next two months. According to Lobb and Wood (1971) in July, spiders and earthworms are highly consumed by *Sturnus vulgaris*, during which there is a low density of insects. Between September and May *Irenimus* spp. and *Dryopais variabilis* (Curculionnidae) appear to be strongly present in the droppings of starlings. Weevils are considered an important source of food. *Costelytra zealandica* (Scarabaeidae) is strongly ingested as adult in November-December and larvae between March and May. *Agrotis ypsilon* (Noctuidae) appears regularly in the diet of starlings but more frequent in January. Coleophora spp. (Coleophoridae) appears in larval faeces from January to April.

Relative Abundance of Ingested Species and Diversity of *Sturnus vulgaris* Diet

In the stomach contents of 19 Starling collected in December in New Zealand where the starling nests, Moeed (1975) notes the abundance of Coleoptera with 61.3% of which *Graphognathus leucoloma* (18%), followed by Lepidoptera with 11.3% represented by a caterpillar of Noctuidae indeterminate (15%), the most abundant species is Heteroptera with 11.3% which *Rhodopsalta* sp. is the most represented. On the other hand, Coleman (1977) notes in New Zealand between February and April *Irenimus aequalis* (Curculionidae, Coleoptera) as the most abundant species with a rate of 92.2% in the European starling trophic menu, followed by *Hyperodes bonariensis* (Curculionidae) and *Enneboeus* sp. (Tenebrionidae).

In this work, European starling seems to have a preference for fruits such as olive and pistachio-lentisc and insects such as Hymenoptera with *Messor barbara* and Coleoptera. Several authors confirm this tendency for Hymenoptera and Coleoptera (Moeed 1975; Coleman 1977). This is probably due to their availability during the winter-automn. That how Doumandji and Doumandji-Mitiche (1996) noted in the Surnus vulgaris faeces 14 olives pulp and hackberry fruit leftover (*Celtis australis*). This bird reject many small oleaster pits (*Olea europaea oleaster*), large olives pits (*Olea europaea europaea*) and even Palmaceae seeds such as *Washingtonia filifera* and *Washingtonia robusta*. In the starlings breeding area, the major part of the diet of this spices consists mainly of insect, arthropods especially when they swarm (Havlin and Folk 1964 cited by Cramp & Perrins 1994; Gromadzki 1969; Moeed 1975; Coleman 1977). Indeed, Poland Gromadzki (1969) note after analysis of 85 stomach contents, high frequencies for Diptera (45.6%), Coleoptera (31.2%) and Lepidoptera (13.2%). Other taxonomic groups are present by 9.4%.

Regarding the equitability the lowest values of E close to zero imply that there is an imbalance between the number of species, and therefore one or two species dominate, and highly consumed. Regarding the different types of vegetal fragments contained in the droppings, equitability is quite high. It varies between 0.55 and 0.80 with a tendency towards 1. This confirms that the number of vegetal species consumed tend to be balance between them. These results show that *Sturnus vulgaris* is an opportunist; it adapts itself to the environment availability. Sometimes its trophic diet is unbalanced. In this case, it is permissible to say that it is an opportunistic species. neither Gromadzki (1969), or Lobb and Wood (1971), or Moeed (1975) or Coleman (1977), or Tinbergen (1981) or Moore (1986), and neither Doumandji & Doumandji-Mitiche (1994, 1996) nor Williams and Karl (1996), or Isotti (1997), or Gibb (2000) and neither Trotta (2001) who studied yet the diet of the starling have used diversity indices and the equitability to exploit their results.

CONCLUSIONS

In the Mitidja plain part of its hibernation area, the European starling ingests less food than in Europe its breeding area. It should be noted that it ingests in the Mitidja many more animals prey than plants. This study highlights the importance of the animal part in the digestive tracts of *Sturnus vulgaris*, with more than 4/5th of the food intake against less than 1/5th of vegetable part. It consumes Sturnidae especially Coleoptera and Hymenoptera and behaves as insectivorous predator in its breeding area. However, in the study area, the intake of fruits rich in carbohydrates and fats such as olives, dates, pistachios to allow it to rebuild its reserves for the return flight.

ACKNOWLEDGEMENTS

My sincere thanks and gratitude addressed to Professor DOUMANDJI Salaheddine of the National School of Agronomy El Harrach, for agreeing to be my research director, for his invaluable advice and have always been present to

orient myself. My sincere thanks go to him for long hours to determine the species found in the stomach contents of *Sturnus vulgaris* patiently and to correct this document.

Mr. Boualem RAHMOUNI he be thanked for the many hours for many days and even weeks that I have spent accompanying me in the field and for his help during manipulations in the study sites. I will not be forgetting to thank him for his financial support without which this work would not have been possible.

I want to thank you Mr. HAMACHE and Mr. MOKABLI that have made me enjoy their fruitful comments about starlings. I hope they find my sincere gratitude.

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